

UK Patent Application (12) GB (19) 2 315 384 (13) A

(43) Date of A Publication 28.01.1998

(21) Application No 9714687.2	(51) INT CL ⁶ H04M 3/50 , G06F 9/46 , H04Q 3/00
(22) Date of Filing 11.07.1997	(52) UK CL (Edition P) H4K KDD KF50X
(30) Priority Data (31) 2181009 (32) 11.07.1996 (33) CA	(56) Documents Cited GB 2308780 A GB 1425235 A EP 0013301 A1 WO 83/04117 A1 US 5317749 A US 5297283 A US 4961224 A
(71) Applicant(s) Mitel Corporation (Incorporated in Canada - Ontario) P O Box 13089, Kanata, Ontario K2K 1X3, Canada	(58) Field of Search UK CL (Edition O) G4A AFN , H4K KDD KF42 KF50A KF50E KF50X INT CL ⁶ G06F 9/46 , H04M 3/42 3/50 , H04Q 3/00 ONLINE : WPI
(72) Inventor(s) Paul Erb Danny Normand Prairie	
(74) Agent and/or Address for Service John Orchard & Co Staple Inn Buildings North, High Holborn, LONDON, WC1V 7PZ, United Kingdom	

(54) Resource management in a multiple process system

(57) In a method of resource management in a multiple process system, an owner list 33 of resource stores for each of the various resources the identity or identities of the process or processes which currently have access to, or the right to use, that resource. Only a process listed with a resource is allowed to use that resource. A process may be added to the owner list for a particular resource if that process meets certain selection criteria. A free list 29 of available resources may be provided in which a resource is marked as busy (marker "-1") when that resource has a process stored with it in the owner list 33, and a resource is marked as idle in the free list 29 if that resource has no process stored with it in the owners list 33. An owner count record 35 indicates how many resources currently have access to each resource. The method may be used in an automatic call distribution system in which the resources are call agents, and the processes are incoming call (customer) processes CUST, supervisor processes SUP and free agent processes. The method may also be used to manage all subscriber calls in a PABX system, in which the resources are lines and trunks, and the processes are incoming and outgoing call PABX routines.

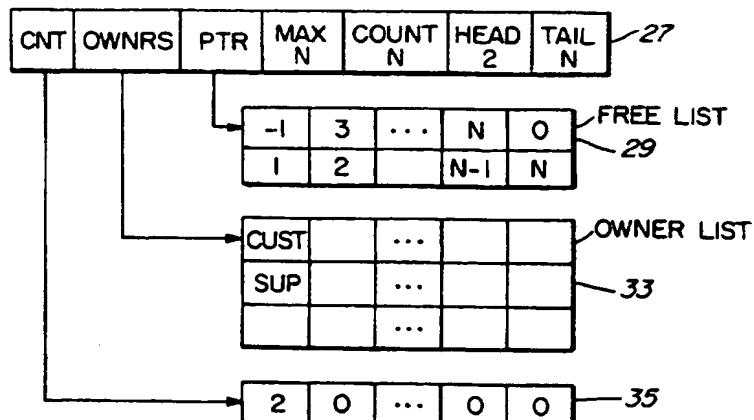


FIG. 9

GB 2 315 384 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

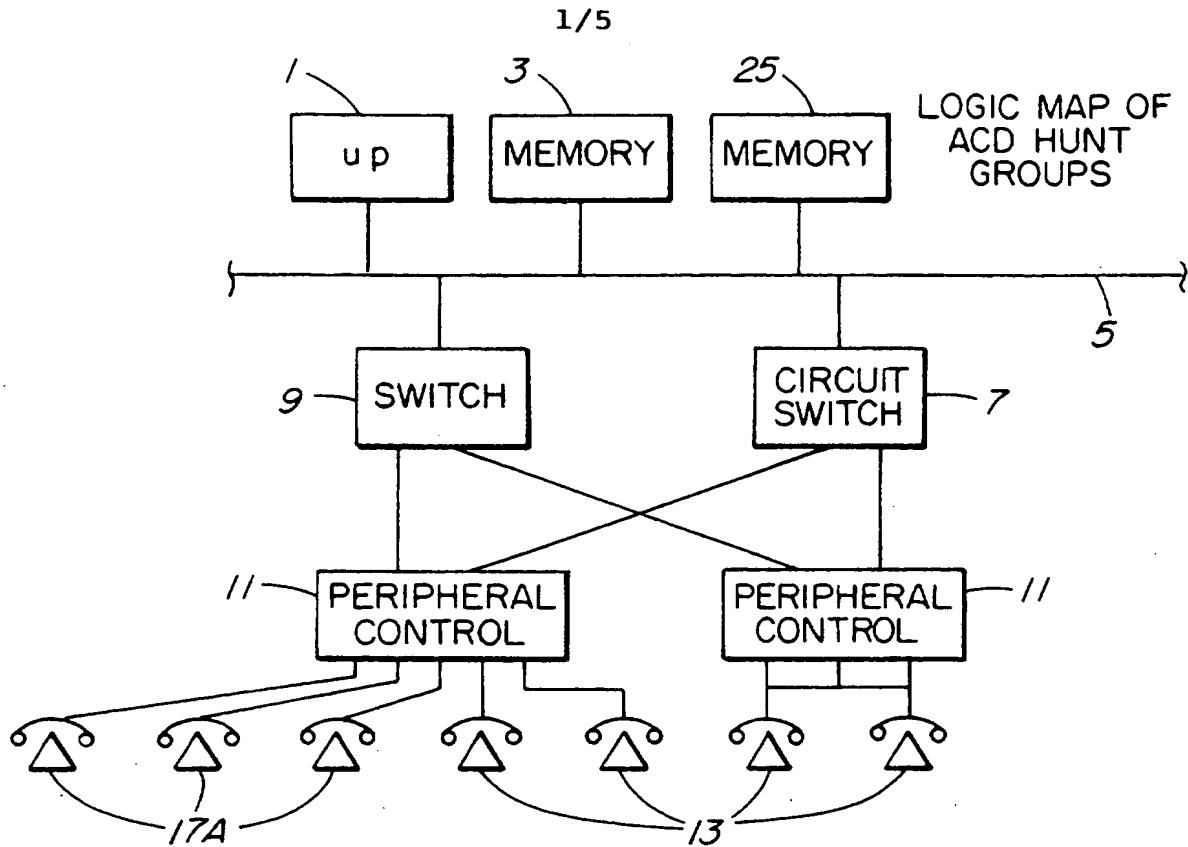
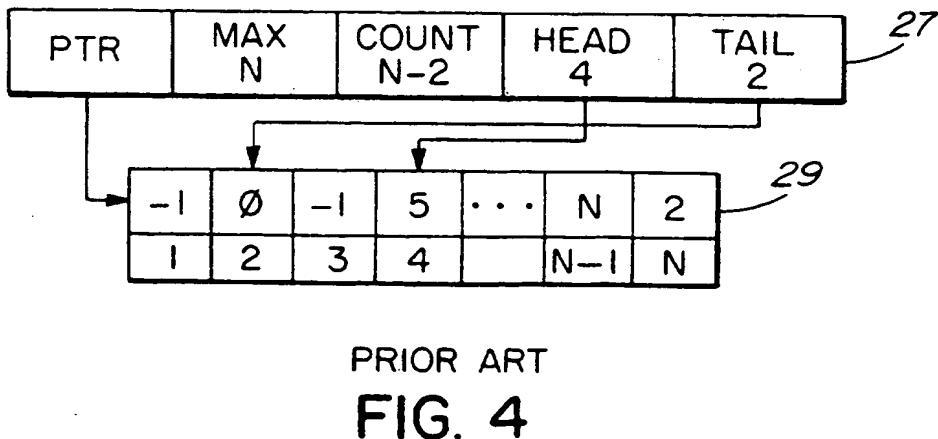
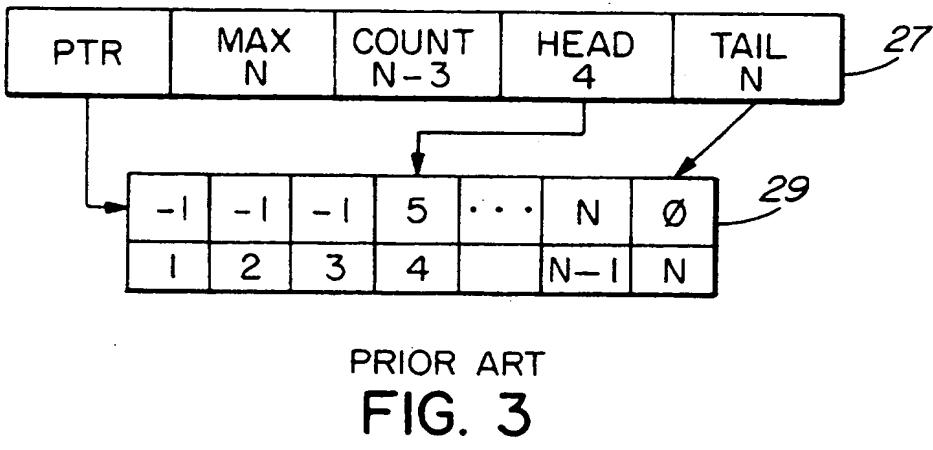
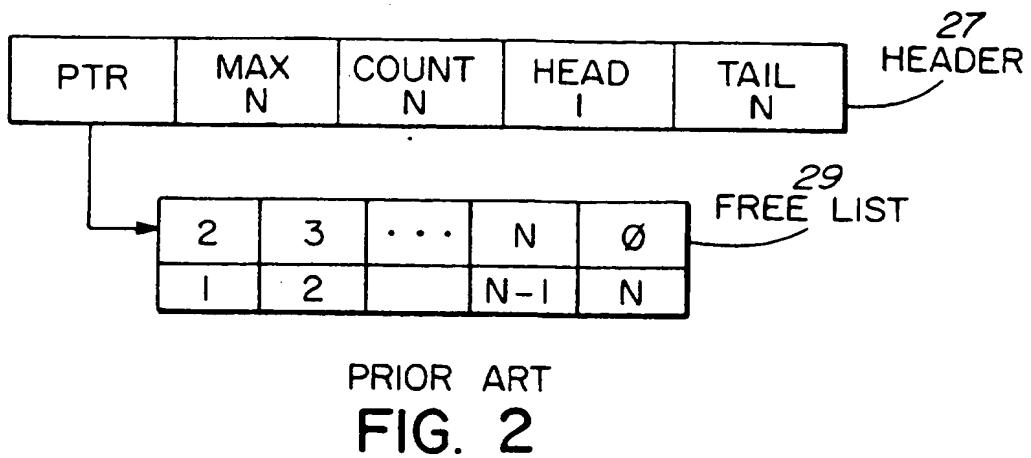


FIG. 1

1. FUNCTION `canBecomeOwnerOf` (`potential_owner`, `resource`): BOOLEAN
2. BEGIN
3. IF (`resource` is in use AND
 4. `potential_owner` = supervisor) OR
 5. (`resource` is NOT in use) THEN
6. RETURN TRUE;
7. ELSE
8. RETURN FALSE;
9. ENDIF;
10. END;

FIG. 7



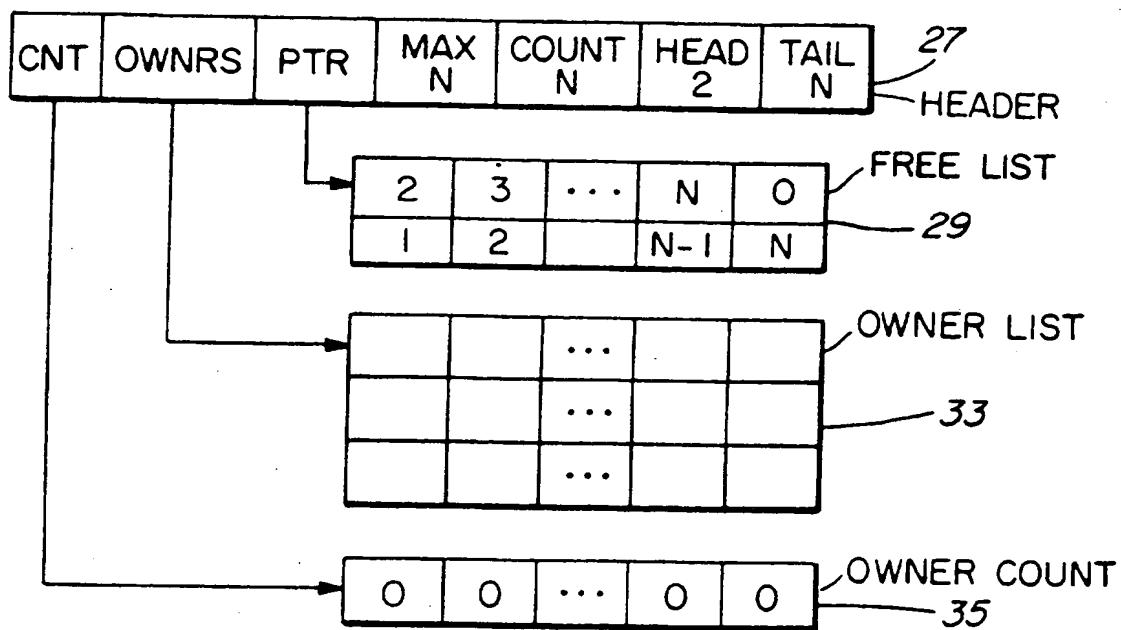


FIG. 5

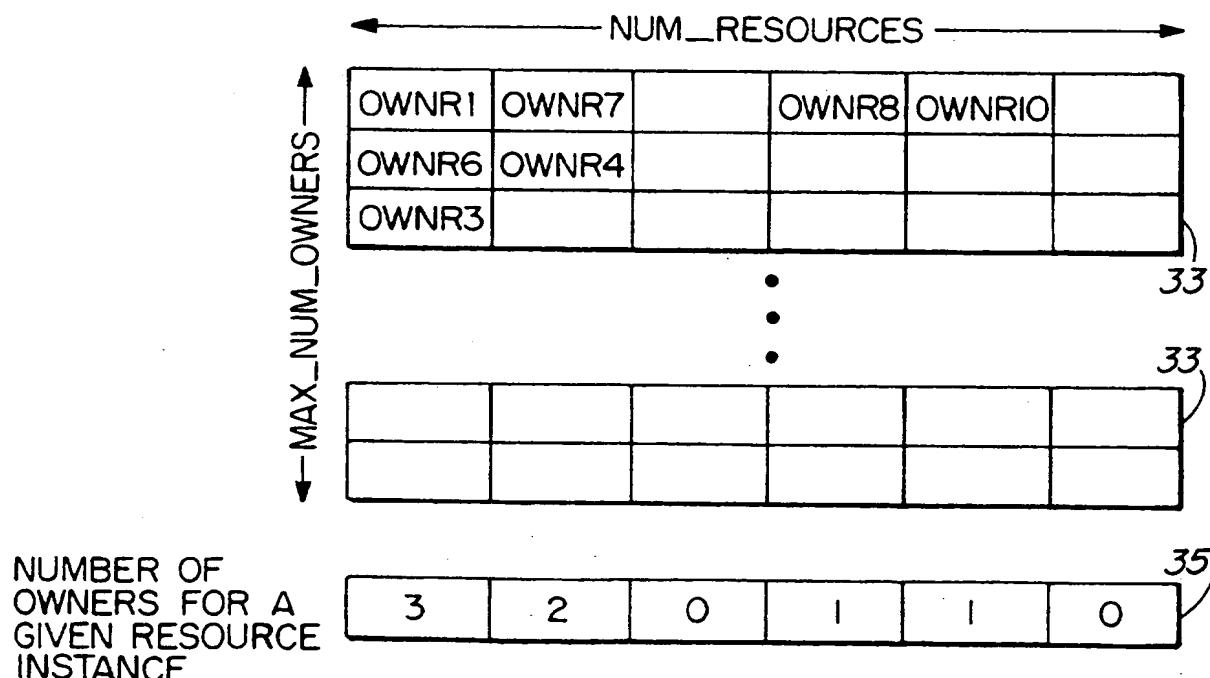


FIG. 6

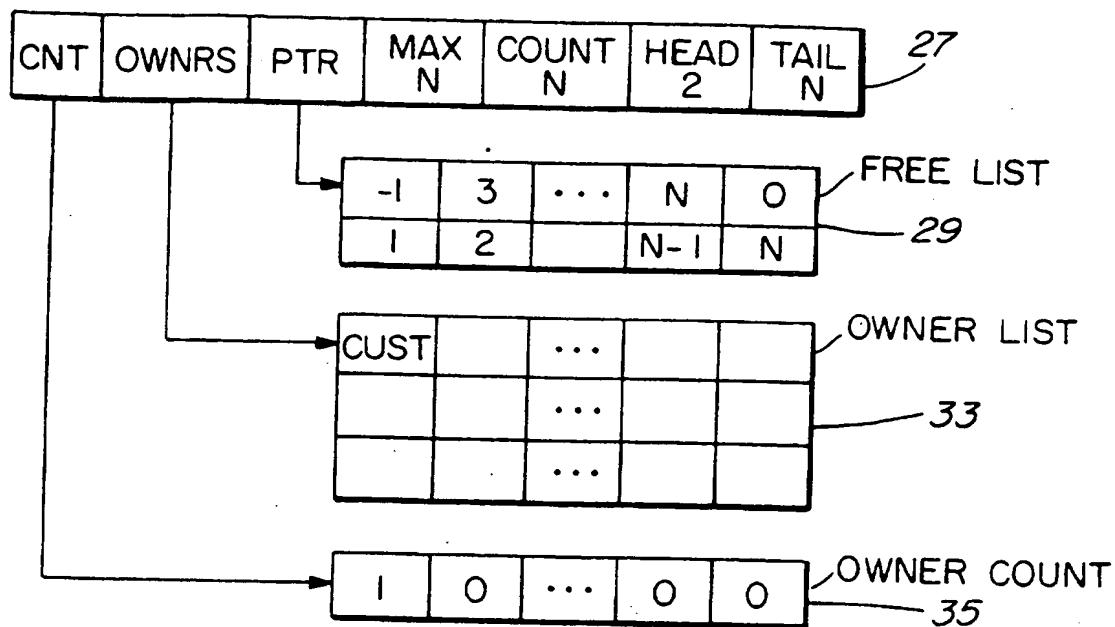


FIG. 8

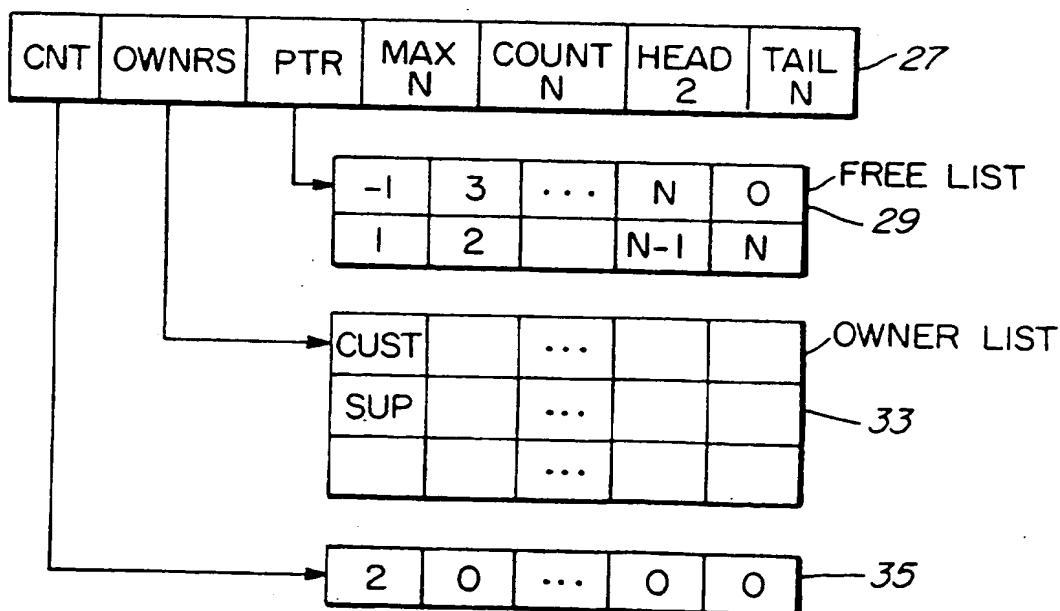


FIG. 9

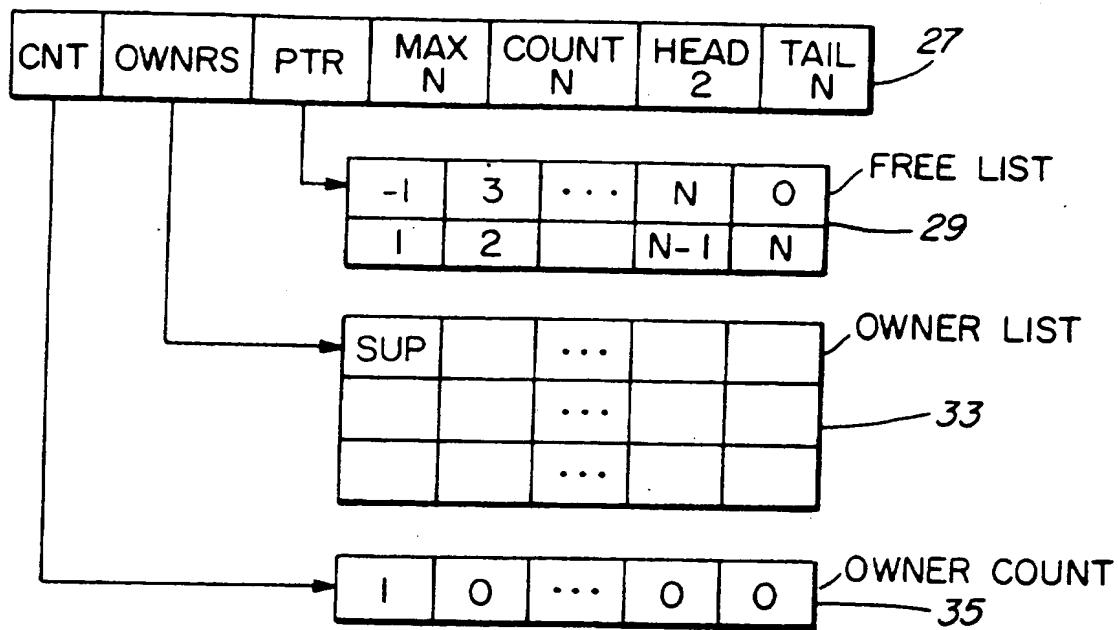


FIG. 10

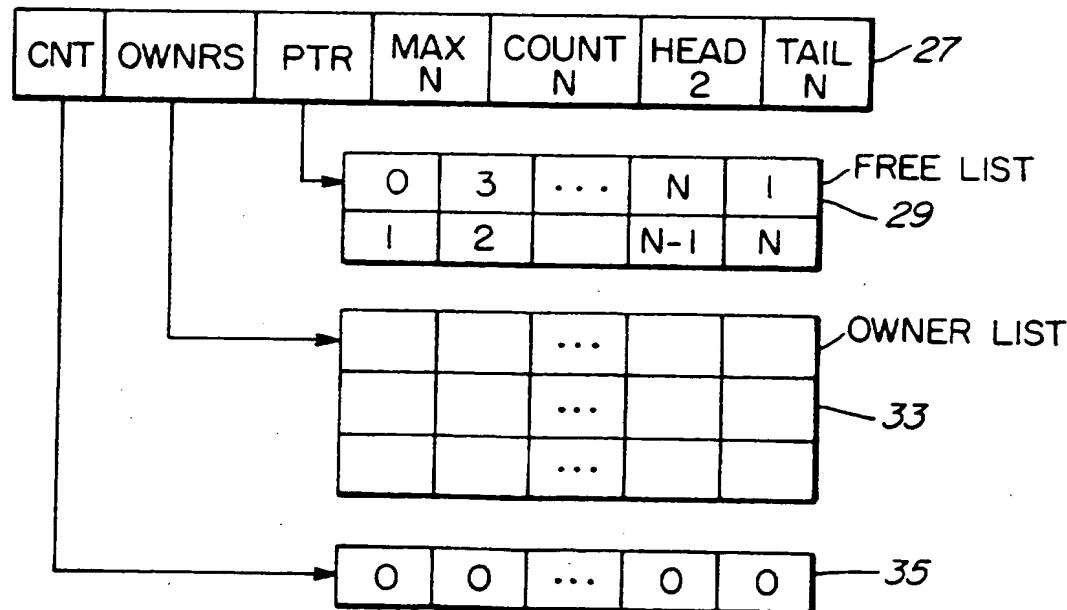


FIG. II

MULTIPLE OWNER RESOURCE MANAGEMENT

This invention relates to methods of managing resource elements such as those used in telephone switching systems.

5

Telephone switching systems such as PABXs and central offices provide specialized applications, such as automatic call distribution (ACD) which distributes incoming calls among agents. Such systems can be used 10 for answering inquiries as to departure or arrival times of aircraft, to take reservations for theater, aircraft, trains, etc., to take telephone orders, etc.

In such systems, when a subscriber calls a telephone number, such as an 800 or 888 number, the 15 telephone system routes the call to an idle agent within a hunt group of agents accessed by the number. All agents within the group are accessible by the same number, but the system determines which agent has been the "longest idle agent" and routes the call to that 20 agent.

U.S. Patent 5,515,428, issued May 7, 1996, invented by Mark Sestak and Paul Erb, and assigned to Mitel Corporation, describes prior art methods and a new method for keeping track of idle agents and for 25 identifying which agent is the longest idle agent. In such systems, when an agent is servicing a caller, the agent's line is marked as busy, and the agent becomes unavailable for other calls. Thus in the event another caller attempts to call the agent, the request is 30 denied.

However, it is sometimes necessary for the agent to access a supervisor or an information source line and conference the supervisor's or information line with that of the customer. With the agent's line being

marked as busy, this has not been able to be done in such systems.

5 In accordance with an embodiment of the present invention, resources such as agent's lines are listed, e.g. in a table, and processes for operating various functions of the system, such as a process for operating a supervisor's line, are entered against each resource. Plural processes can be entered against a 10 particular resource; all processes that are entered against a particular resource are allowed to use the resource independently or together.

15 For example, assume that both an agent process and a supervisor process are entered in a list in the table with the agent resource. During a call in progress, the supervisor requests to join the call. By the use of the present invention, the associated supervisor process sends a message to the agent process and awaits an acknowledgment or rejection of the request. 20 If the request is allowed, the three processes comprising the agent process, the calling party process and the supervisor process perform a hand-off of their associated lines to a conference process, which manages the lines until any party leaves the conference. At 25 this point the conference process performs a hand-off of the parties back to the original processes for subsequent handling.

30 Thus in such a system, even with the agent's line being marked as busy, the supervisor can join the conversation in a conference.

In the event additional callers are required to join the conference, the conference process accepts or rejects the request and exchanges messages with all associated processes to add the new caller, if accepted.

The above process can be implemented with ownership management, ownership management being the subject of the present invention. The ownership management is preferably used in conjunction with the free list described in the aforenoted patent.

In accordance with an embodiment of the present invention, a method of management of resources in a multiple process system is comprised of providing a list of resource owner identities, storing in an owner list the identity of at least one process (process) with a resource with which the at least one process has a right to interact and use, allowing any process listed with a resource to use the resource, and barring access of the resource to other processes in the event there is at least one process listed with the resource.

In accordance with another embodiment, the method includes providing a free list of available resources, marking a resource in the free list as busy when the resource in the free list has a process stored with it in the owner list, and marking the resource in the free list as idle when the resource in the free list has no process stored with it in the owner list.

It should be understood that the present invention is not restricted to be used with ACD systems, but is applicable to the management of any analogous resource, the use of which can be controlled by the system. Thus while an example will be given of the use of the invention in an ACD system, it can be used to manage any multiprocessing system which contains plural processes that must use and share resources amongst themselves, such as a PABX or other system.

A better understanding of the invention will be obtained by considering the detailed description

below, with reference to the following drawings, in which:

5 Figure 1 is a block diagram of a telephone switching system in which the present invention can be implemented,

Figure 2 illustrates the content of a memory in Figure 1 after initialization in accordance with the prior art,

10 Figure 3 illustrates the content of the memory in Figure 1 after initialization at a point during use,

Figure 4 illustrates the content of the memory of Figure 1 after initialization at another point during use;

15 Figure 5 is an illustration of a free list data structure after initialization,

Figure 6 is an illustration of a logical structure of an owner list and owner count in accordance with an embodiment of the invention,

20 Figure 7 is a pseudo-code description of a function "can_become_owner_of",

Figure 8 is an illustration of a free list facilities data structure after a process has become listed as an owner of a resource,

25 Figure 9 is an illustration of a free list facilities data structure after a second process has become listed as an owner of a resource,

Figure 10 is an illustration of a free list facilities data structure after the first owner process has become unlisted as an owner of a resource, and

30 Figure 11 is an illustration of a free list facilities data structure after a second process has become unlisted as an owner of a resource.

Figure 1 illustrates a representative system 35 in which the invention may be contained. The basic

system may be as described for example in U.S. Patents 4,616,360 and 4,615,028, invented by Conrad Lewis et al, which are incorporated herein by reference.

Basic elements of that system are a
5 microprocessor 1 and a memory 3 accessed by
microprocessor 1, both of which are connected to a main
system bus 5. Memory 3 contains the main operation
programs of the system as well as data as to the status
and location of lines and trunks, etc.

10 A circuit switch 7 and a message switch 9 are
connected to bus 5 for control by microprocessor 1.
Peripheral control systems 11 are connected to line
circuits to which telephones 13 are connected, and are
connected to circuit switch 7 for switching telephone
15 circuits between telephones 13 and trunks in order that
communication signals may pass therebetween. The
peripheral control systems 11 are also connected to
message switch 9, whereby control messages from
microprocessor 1 may be passed thereto, for controlling
20 the line circuits or other peripheral circuits or for
other well known peripheral control duties.

Agent terminals 17 such as telephones are
connected to peripheral control system 11.

25 In general the agent terminals are grouped
into hunt groups (which may be only a single hunt group
or many hunt groups). When a call is received to e.g. a
particular number such as an 800 number, the
microprocessor, comparing the called number with a hunt
group list stored in memory 3, checks the number stored
30 in memory 3 and routes the call to one of the agent
terminals 17A within the designated hunt group.

It should be recognized that in another
design, an ACD circuit can be connected to the main bus
5 and can be accessed directly by microprocessor 1 from
35 that bus, or an ACD circuit can be connected to a

peripheral control system 11. Whether agent terminals 17A are connected to such ACD circuits or whether they are connected directly to line circuits accessed by the peripheral control system 11 is not consequential to the 5 present invention. Techniques for detecting the off-hook condition of a terminal and of connecting it to another terminal are well known, and a description thereof would be redundant.

In accordance with the prior art, to determine 10 the oldest available agent, a so-called free list of signals representative of the number of each available agent (i.e. the terminal number of that agent), each associated with one or more hunt group numbers, was stored. For example, each hunt group number "2000" 15 would have the customer designated agents associated therewith, e.g. "5001", "5002" ... "5010". The number of records in the free list would be equivalent to the maximum number of agents which could be programmed into the entire system. Each agent record is associated with 20 a unique agent number.

When an agent logs onto the system, the agent number is added to the end of the free list, thus indicating that the agent is ready to receive calls.

When a call arrives for a hunt group number, 25 the microprocessor accesses the free list and begins a search for the longest idle agent for that hunt group, starting from start to end of the free list. For every agent on the free list, the look-up checks to determine if the agent is a member of the desired hunt group. The 30 first positive determination is thus an indication that the associated agent number designates the longest idle agent, due to the ordering of the list. The microprocessor then controls the telephone system to route the call to that longest idle agent, and the agent 35 record is logically removed from the free list. This is

achieved by adjusting the free list linkages to skip the removed record.

When the agent completes the servicing of the call and returns to the idle state, the agent record is 5 logically added to the end of the free list. Since that agent record is added to the end of the free list, the records are automatically in the longest idle agent order if the free list is traversed from beginning to end.

10 In prior art systems, memory 25 is provided connected to bus 5 for access by processor 1. Memory 25 is stand alone, or part of memory 3.

15 Figure 2 illustrates the signal content of memory 25 immediately after initialization when all agents are idle. Memory 25 stores signals which allow the processor to designate which agent (i.e. element) is to be used to service a call.

20 The stored signals are comprised of a header (record) 27 as well as a free list 29. The free list contains in successive memory locations 1, 2, ... N-1, N, the identifier of the next "longest-idle" agent. Traversing this list, we see that the longest idle agent is agent "1", followed by "2", "3" and so on. Somewhere in the system, there is an association agent 25 "1" and the agent's extension number (e.g. 5001, 5002, etc.).

30 A second field MAX contains a count N of the maximum number of elements, e.g. the maximum number of agents which can log onto the system. The next field COUNT contains a signal which indicates the maximum number of free elements, e.g. the number of free agents. Immediately after initialization, the maximum number of elements equals the number of free elements, shown as N.

35 The next field, HEAD, is an index pointer to the first record in the free list 29 which is free.

Immediately after initialization, it is to record 1, as shown.

5 The last field, TAIL, is an index to the record of the youngest available element, shown as record N of the free list.

If a different scheme than oldest to youngest were used, HEAD would point to the record of the first element of the list, and TAIL to the record of the last.

10 In use, the microprocessor 1 accesses the header. The pointer PTR points to free list 29 which contains the list of all idle agents. The processor checks the header and then accesses the record of the element, e.g. agent, pointed to by the HEAD byte. In the case of Figure 2, the pointer HEAD is to the first 15 record in the free list 29.

20 The processor then routes the call to the agent designated by the number stored in the record of the free list (e.g. agent 2), and changes that record number to a special designator, such as -1, as shown in Figure 3. The number stored in the HEAD byte is then changed to the numeral 2, designating record number 2, and the number stored in the COUNT byte is decremented by 1.

25 Figure 3 illustrates the state of the header 27 and free list 29 after the first three agents have been made busy and their records changed to -1. It may be seen that the number stored in the HEAD byte is 4, pointing to the fourth record in the free list. The number stored in the COUNT byte is N-3, which indicates 30 how many agents are left in the free list. The first three records store the numeral -1, since the associated agents are no longer free.

35 Thus when the processor wishes to connect the call to the longest idle agent, accessing the HEAD field in the header 27 points the processor directly to record

number 4 where the search begins for the longest idle agent in the requested hunt group. In case the COUNT has been decremented to zero, the processor can route the incoming call to a recorded announcement. Each 5 record needs to be read until the longest idle agent for the hunt group is found.

Figure 4 illustrates the state of the header 27 and free list 29 after, for example agent or element designated by reference numeral 2 has completed its 10 servicing of a call and is returned to the free list. Each successive digit number or element which becomes free is returned to the record immediately following the record number of the youngest idle element, which is designated by the content of the TAIL field in header 15 27.

In Figure 4, for example, the HEAD byte in header 27 points to record 4 in the free list, which is the first agent in the free list, while the TAIL byte of header 27 indicates the last agent in the free list is 20 agent 2. When scanning the free list, therefore, the oldest idle element would be indicated immediately as agent 4. Each field in the free list is accessed sequentially, looping from the oldest to the newest record, the TAIL of the free list pointing to record 25 number 2, which represents agent number 2. It may be seen in Figure 4 that record N contains element number 2, which had been placed in that record since agent 2 had been returned to the free list.

It may be seen that as there are only two 30 elements in free list 29 indicated as being busy, those designated in the first and third records as -1, the byte stored in the COUNT field of header 27 is N-2.

Items returned to the free list need not necessarily be placed as the youngest record, but could 35 be returned anywhere in the free list, depending on the

application. Further, the processor could scan the free list in any desired manner, not necessarily in a looping sequence from the oldest idle element to the youngest idle element, as described above.

5 In accordance with an embodiment of the present invention, the header 27 in any such system is expanded as illustrated in Figure 5 to include a field OWNRS which contains a pointer to an owner list 33. An entry in this field is an indicator that the free list
10 is resource ownership managed.

15 The header also includes a field CNT, which contains a pointer to an owner count record 35 which contains fields containing a count of how many owners there are of each of the resources, i.e. how many processes have access to a particular resource during a particular time.

20 The owner list 33 and the owner count record 35 can be stored in a table or tables in the same memory as free list 29.

25 The owner list and the owner count record are used to coordinate the allocation and release of resources to the proper owners.

30 Reference is now made to Figure 6, which illustrates the owner list 33 and the owner count record 35 in more detail. When ownership management is enabled, for example by reading the OWNRS field in header 27, a list of owners for a given resource is stored in table 33. The list of owners in table 33 can be represented by a number of different data types, but can be thought of logically as a two dimensional array as illustrated in Figures 5 and 6. In addition, a one dimensional array containing the owner count 35 is also used, to contain the number of owners for a given resource instance.

The structure which stores resource owners has columns labeled num_resources, wherein each column contains an identity of the owners (referred to herein simply as "owners" of a given resource instance. By 5 "owners" is meant "the right to use"). The rows are labeled max_num_owners, designating the quantities of resource owners that can be given ownership of a given resource.

In the example shown in Figure 6, in the case 10 of the resource instance corresponding to the second column of the table, there are two entries corresponding to its owners ownr7 and ownr4. The second element of the one dimensional array (the owner count 35) stores the number of owners for the resource instance 15 corresponding to the second column of the table, and in this case contains the number 2, corresponding to the two entries for this resource. Similarly, the first entry of the one dimensional array stores the number 3, corresponding to the three owners ownr1, ownr6 and ownr3 20 of the resource corresponding to the first column in the owner list array 33.

The purpose of ownership management is not solely to store owners, but also to prevent certain 25 potential owners from becoming owners of a resource. If we consider an example where the owners of resources are processes, a request by a process to obtain ownership of a resource may be denied based on predetermined characteristics of the requester or of the current owners of a resource.

30 As functions of the free list management facility are called, the owner list and owner count of resources are updated to reflect the operations performed by these functions. It should be recognized that many different types of owners can be allocated

against resources, such as C++ or Smalltalk objects, processors, etc.

5 Five functions or routines can be used to implement a preferred embodiment of the present invention, as will be described below.

10 1. A function "initialize_free_list" should be called to initialize the free list of available resources, and to set each resource's number of owners to zero. Once initialized, the owner list 33 and the free list 35 will be as shown in Figure 5, wherein no owners are entered in the owner list, and the owner count for all resources is zero.

15 20 When this function is called, the selection criteria that must be met for an owner to be successfully granted ownership of a resource should be defined. These criteria can be defined in any number of ways, such as a function call, hard coded decision statements, etc. For example, an agent process can be hard coded logically so that it cannot own another agent resource, but a supervisor process can be hard coded logically so that it is allowed to own any agent resource, or only certain agent resources.

25 30 This initialization function should be the first function of the free list management facility called, since all other functions of the facility should be able to assume that the structures have been initialized.

35 2. A function "get_resource" should be called to obtain a free resource. When ownership management is enabled, this process is added to the list of owners for the resource being allocated, if it meets the selection criteria defined when "initialize_free_list" was called.

3. A function "return_resource" should indicate that the owner no longer requires a given resource, when called. The process which calls this routine is removed

from the resource's list of owners. If after removing the caller of this routine from the list of owners, the list is empty, the resource is returned to the free pool.

5 4. A function "add_ownership" should allow several owners, in this case processes, to share and use a common resource. One way by which a process can use an already allocated resource is through the use of this function. By calling this function, a process is added 10 to a resource's list of owners if it meets the selection requirements defined when "initialize_free_list" was called.

5. A function "transfer_ownership", when called, should allow a process to pass ownership from one 15 process to another. Thus when an owner has finished using a resource, instead of returning the resource to the free pool, the owner can instead pass ownership on to another process. The process to receive ownership must meet the selection criteria that was defined when 20 calling "initialize_free_list", or the transfer should not be successful.

An example will be given below in which ownership management is made of call agents in an ACD system, where call agents are considered to be 25 resources, and the owners of such resources are processes associated with call parties which talk with a call agent.

Before agents can be allocated and obtained, the free list management facility must be initialized 30 for use. This is done by the main system processor calling the function "initialize_free_list" with the following parameters:

(a) The resource type of free list management facility to be initialized. In this example, this would 35 be agents.

(b) The number of agents in the system (N in this example).

(c) The selection criteria for ownership. In this example, the selection criteria can be encoded in a function called "can_become_owner_of". An example in pseudo-code of the function is shown in Figure 7.

5 (d) The maximum number of concurrent owners for a given resource type, e.g. 3.

The data structure resulting from calling the initialization routine is shown in Figure 5.

When a customer calls an 800 or 888 number which is part of an ACD system that uses the present invention, the facility creates a process which is associated with the incoming call from the customer.

15 This process will be referred to below as the customer process. This newly created process then tries to obtain an agent to service the customer's call. To do this, the process calls the "get_resource" routine with, as a parameter, the resource type to be obtained, which
20 is an agent in this case.

Assuming that there are free agents, the customer process becomes an owner of an agent, is entered into the owner list 33 in the column related to the agent, the owner count is incremented by one, and the customer's telephone line is connected to the telephone line of the agent by the telephone system, under control of the processor of the telephone or ACD system.

Figure 8 illustrates the state of the above-described data structures at this stage. Agent No. 1 is updated in the free list 29 from agent availability 2 (Figure 5) to -1 (busy), as described in the aforenoted U.S. patent 5,515,428. The owner list 33 is updated to enter the owner (process) CUST in the column relating to the particular agent (resource), as may be seen by

comparing Figure 5 and 8). The owner count for the particular agent is changed from 0 (Figure 5) to 1 (Figure 8).

Assume now that a supervisor is to be added to the conversation between the customer and the agent. The supervisor must first add itself as an owner of the agent. To do this, the "add_ownership" routine is called, e.g. by the supervisor dialing a predetermined code which is detected by the system processor, by closing a soft key switch on the telephone of the supervisor, etc. This results in the supervisor process SUP being added to the list of owners of the agent resource, as shown in Figure 9, and the owner count for that resource being incremented from 1 to 2.

15 As noted earlier, the supervisor process
cannot be added to the owner list unless it meets the
selection requirement defined when "initialize_free_
list" was called. When the supervisor requests that it
should join the conversation, as noted above, its
20 associated supervisor process sends a message to the
agent process and awaits an acknowledgment or rejection
of the request. The agent process can read the list of
its owners from the owner's list to determine that the
request should be accepted. If the request is accepted,
25 the agent, customer and supervisor processes perform a
hand-off of their associated call to a conference
process which manages them until any party leaves the
conference. At this point the conference process
performs a hand-off of the parties back to the original
30 processes for subsequent handling.

In the event that other parties are to join the conference, the conference process accepts or rejects the request by checking whether the other parties are listed as owners of the resource in the owner list.

In certain circumstances, a second agent may wish to consult a first agent. In this case, the second agent will try to add itself (the identity of its process) to the owner's list of the first agent resource, by the second agent's process calling the "add_ownership_ routine". The ownership may not be granted, if the function shown in Figure 7 returns FALSE. In this manner, the second agent process is barred from obtaining ownership of the first agent resource, and the lines of the two agents will not be connected by the system.

In the termination of the conference call between the customer, the agent and the supervisor, e.g. when the customer hangs up, the customer process calls the "return_resource" routine to indicate that the customer process no longer requires the use of the agent resource. The "return_resource" routine modifies the owner list entry for the agent to remove the CUST process owner, leaving the SUP process owner listed in the agent resource column, as shown in Figure 10. The owner count for the agent resource is decremented by one from 2 to 1. Since an owner of the resource still exists (SUP), the availability of the agent in the free list remains -1, indicating that the agent is not available to take additional calls, and the agent is not returned to the free pool.

The conversation at this point is between the agent and the supervisor, since the customer has hung up.

When the supervisor hangs up, the supervisor's process calls the "return_resource" routine for the agent. The process SUP is removed from the agent resource record, resulting in the owner list as shown in Figure 11. Since the supervisor's process was the only remaining owner, the owner count for the resource is

decremented to 0, and the free list for the resource is changed from -1 to 0, indicating that the resource is free.

It will be recognized that the identity of the owner 5 can be different than that described; for example the process identifier can be any data that will indicate a particular owner can own or operate the resource. The acceptance criteria used, when adding a new owner to the resource, can be changed at any time, including during 10 the processing of a call.

While the example given above was specific to the processing of an ACD feature of a telephone switching system, the invention can be used for other purposes, such as to manage all subscriber calls in a PABX system. 15 When a subscriber call is delivered to any destination, the destination can become owned by the subscriber process and a busy process. All subsequent calls to the destination would use the multiple owner resource management system described above to request ownership of 20 the destination (i.e. accepted into the call in progress, or rejected from joining the call in progress), and to release the destination (drop from the call). When all owners of the destination have released ownership the destination becomes idle (free) and available for any new 25 call.

It will be understood that the terms "resource elements", "resource entities" and resource, where used in this specification and claims refer generally to

structures in products. Thus, for example, on page 2 line 5, it is explained that, in one embodiment the resources are hardware such as agents' lines.

Furthermore, the word "process" is used to refer to 5 a particular step in a method of operation. Thus reference is made in one arrangement to a process for operating a supervisor's line, and in another to a conference process which manages the lines associated with a conference.

10 The references to the "owners" of the "resources" and to "owner's list" are concerned, not with an owner in the sense of personal ownership, but with a structure which contains electronic signals which designate the identities of resource structures and those structures 15 which are empowered to use them. A structure relates to the manner in which electronic signals are associated one with another, for example to a memory and a database stored therein. It will be noted that on page 10 there is a reference to modifications of a header 27 of an 20 owner's list 33, which is stored in a memory 25 (page 7 lines 10-25).

The above terms and expressions have been 25 specifically mentioned, because, although they are known and understood by those skilled in this fast developing art, they may not be so familiar to those less involved in the development of the technology. The methods of operation described relate to the operation of a structural system, which may for example, be a PBX, or

other multiple process system.

The resolution of the problem set out in the introduction to this specification has resulted in the development of a new method of operation of a system which employs multiple structural resources, allocating those resources to user structures in the system, and enabling them to fulfil their required functions.

It will be understood that, although particular arrangements illustrative of the invention have been described by way of example, variations and modifications thereof, as well as other embodiments may be made within the scope of the appended claims.

CLAIMS

1. A method of management of a resource in a multiple process system including the steps of
 - 5 (a) storing in a memory an owner list of resource identities (resources),
 - (b) storing in the owner list the identity of at least one process (process) with a resource which the at least one process has a right to operate, and
 - 10 (c) allowing only a process listed with a resource to use the resource.

2. A method as defined in claim 1, including
 - 15 (d) barring access of the resource to other processes in the event there is at least one process listed with the resource and the resource is busy.

3. A method as defined in claim 1, including providing a free list of available resources, marking a
 - 20 resource in the free list as busy when the resource in the free list has a process stored with it in the owner list, and marking the resource in the free list as idle when the resource in the free list has no process stored with it in the owner list.

25

4. A method as defined in claim 3 including adding a particular predetermined process to the owners list with a busy resource and allowing the predetermined

process to access the busy resource.

5. A method as defined in claim 4 including
allowing the predetermined process to access a busy
5 resource in the event that the predetermined process
includes selection criteria allowing the access.

10 6. A method as defined in claim 4 in which the
system is an automatic call distribution (ACD) facility,
resources are call agents, and processes are incoming
call (customer) processes, supervisor processes and free
agent processes.

15 7. A method as defined in claim 3 in which the
system is a PABX, resources are lines and trunks, and
processes are incoming and outgoing call PABX control
routines.

20 8. A method of operation of a resource as claimed
in claim 1 substantially as described herein with
reference to the accompanying drawings.

9. A resource managed by a method as claimed in
any one of the preceding claims.



The Patent Office

22

Application No: GB 9714687.2
Claims searched: 1 to 9

Examiner: M J Billing
Date of search: 25 September 1997

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4A AFN: H4K KDD, KF42, KF50A, KF50E, KF50X.

Int Cl (Ed.6): G06F 9/46; H04M 3/42, 3/50; H04Q 3/00.

Other: ONLINE - WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X,P	GB2308780A (NOKIA) - Fig.4; page 16 line 27 to page 17 line 7	1 at least
X	GB1425235 (IBM) - Fig.1; page 4 line 12 to page 6 line 28	1 at least
X	EP0013301A1 (IBM) - Figs.3,4; Abstract, page 8 line 20 to page 14 line 3	1 at least
X	WO83/04117A1 (WESTERN ELECTRIC) - Fig.2; page 8 line 25 to page 11 line 3	1 at least
X	US5317749 (IBM) - Figs.1,4A; Abstract, column 3 line 54 to column 9 line 39	1 at least
X	US5297283 (DIGITAL EQUIPMENT) - Fig.17, column 22 line 41 to column 25 line 68	1 at least
X	US4961224 (YUNG) - Figs.1-4; column 4 line 27 to column 8 line 17	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.